AMENDMENT TO THE CLAIMS

1. (original) A quadrature modulator compensation system for compensating the transmission of a source signal provided by a signal source data generator, the quadrature modulator compensation system comprising:

a transmitter which translates a baseband transmitter input signal to a local oscillator frequency to generate a transmitter output signal;

calibration circuitry coupled to the transmitter and generating a phase error estimate of the transmitter as a function of an angle of intersection between a desired transmitter envelope and an actual transmitter envelope; and

predistortion circuitry coupled to the signal source, the transmitter and the calibration circuitry, the predistortion circuitry receiving the source signal and the phase error estimate of the transmitter as inputs and providing as an output the transmitter input signal as a function of the phase error estimate of the transmitter.

2 (original) The quadrature modulator compensation system of claim 1, wherein the calibration circuitry is configured to generate a gain error estimate of the transmitter as a function of variation in the actual transmitter envelope, and wherein the predistortion circuitry provides the transmitter input signal also as a function of the gain error estimate of the transmitter generated by the calibration circuitry.

3. (original) The quadrature modulator compensation system of claim 2, wherein the calibration circuitry is configured to determine semi-major and semi-minor axes of an elliptical transmitter waveform, and to generate the gain error estimate of the transmitter as a function of the determined semi-major and semi-minor axes.

4. (original) The quadrature modulator compensation system of claim 3, wherein the calibration circuitry is configured to determine a centroid of the actual transmitter envelope.

5. (original) The quadrature modulator compensation system of claim 4, wherein the calibration circuitry is configured to estimate dc offsets in an in-phase component and a quadrature component of the source signal as a function of the centroid of the actual transmitter envelope.

6. (original) The quadrature modulator compensation system of claim 5, wherein the predistortion circuitry is configured to provide the transmitter input as a function of the estimated dc offsets in the in-phase and quadrature components of the source signal.

7. (original) The quadrature modulator compensation system of claim 1, wherein the calibration circuitry is configured to determine a centroid of the actual transmitter envelope.

8. (original) The quadrature modulator compensation system of claim 7, wherein the calibration circuitry is configured to estimate dc offsets in an in-phase component and a quadrature component of the source signal as a function of the centroid of the actual transmitter envelope.

9. (original) The quadrature modulator compensation system of claim 8, wherein the predistortion circuitry is configured to provide the transmitter input as a function of the estimated dc offsets in the in-phase and quadrature components of the source signal.

10. (original) A method of compensating transmission of a source signal in a quadrature modulator, the method comprising:

calculating an actual transmitter envelope;

calculating a desired transmitter envelope;

determining a phase error estimate of the transmitter as a function of an angle of intersection between the desired transmitter envelope and the actual transmitter envelope;

predistorting the source signal to generate a transmitter input signal, wherein the transmitter input signal is generated as a function of the source signal and the determined phase error estimate; and

generating a transmitter output signal as a function of the transmitter input signal.

11. (original) The method of claim 10, and further comprising:

calculating a variation in the actual transmitter envelope;

determining a gain error estimate of the transmitter as a function of the variation in the actual transmitter envelope; and

generating the transmitter input signal also as a function of the determined gain error estimate of the transmitter.

12. (original) The method of claim 11, wherein calculating the variation in the actual transmitter envelope and determining the gain error estimate of the transmitter further comprise:

determining semi-major and semi-minor axes lengths of an elliptical transmitter waveform; and

determining the gain error estimate as a function of the determined semi-major and semi-minor axes lengths.

13. (original) The method of claim 10, and further comprising:

determining a centroid of the actual transmitter envelope; and

estimating dc offsets in an in-phase component and a quadrature component of the source signal as a function of the centroid of the actual transmitter envelope.

14. (original) The method of claim 13, wherein predistorting the source signal to generate the transmitter input signal further comprises generating the transmitter input signal also as a function of the estimated offsets in the in-phase and quadrature components of the source signal.

15. (original) A quadrature modulator compensation system for compensating the transmission of a source signal provided by a signal source data generator, the quadrature modulator compensation system comprising:

a transmitter which translates a baseband transmitter input signal to a local oscillator frequency to generate a transmitter output signal;

calibration circuitry coupled to the transmitter and configured to generate at least one of a phase error estimate of the transmitter as a function of an angle of intersection between a desired transmitter envelope and an actual transmitter envelope,

a gain error estimate of the transmitter as a function of variation in the actual transmitter envelope, and

a dc offset estimate in an in-phase component and a quadrature component of the source signal as a function of a centroid of the actual transmitter envelope; and

predistortion circuitry coupled to the signal source, the transmitter and the calibration circuitry, the predistortion circuitry receiving the source signal and at least one of the phase error estimate, the gain error estimate, and the dc offset estimate as inputs and providing as an output the transmitter input signal as a function of at least one of the phase error estimate, the gain error estimate, and the dc offset estimate.

16. (original) The quadrature modulator compensation system of claim 15, wherein the centroid of the actual transmitter envelope is determined by the calibration circuitry.

17. (currently amended) The quadrature modulator compensation system of claim 15, wherein the predistortion circuitry is configured to provide the transmitter input as a function of the estimated dc offsets in the in-phase and quadrature components of the source signal.

18. (original) The quadrature modulator compensation system of claim 15, wherein the calibration circuitry is configured to determine semi-major and semi-minor axes of an elliptical transmitter waveform, and to generate the gain error estimate of the transmitter as a function of the determined semi-major and semi-minor axes.

19. (original) The quadrature modulator compensation system of claim 15, wherein the calibration circuitry sequentially generates at least two of the phase error estimate, the gain error estimate, and the dc offset estimate.

20. (original) The quadrature modulator compensation system of claim 15, wherein the calibration circuitry simultaneously generates at least two of the phase error estimate, the gain error estimate, and the dc offset estimate.

This is in Response to the Final Office Action mailed on April 1, 2005 in which claims 1-20 were rejected. Filed with this Amendment are a Petition for Revival for Patent Abandoned Unintentionally, and a Request for Continued Examination. With this Amendment, the dependency of claim 17 is amended and claims 1-20 are presented for reconsideration and allowance in view of the following remarks. It is noted that in sections 2-6 of the Final Office Action, the Examiner provided specific responses to Applicant's previously presented arguments. The Examiner's effort in addressing Applicant's previously presented arguments is appreciated. It is maintained however that pending claims 1-20 are allowable over the cited references.

Rejection of Claims 1-20

In Section 8 of the Final Office Action, claims 1-20 were again rejected under 35 U.S.C. §103(a) as being unpatentable over Carney et al., U.S. Patent No. 5,937,011 (hereinafter referred to as Carney) in view of Kafadar et al., U.S. Patent No. 5,321,726 (hereinafter referred to as Kafadar). The rejection of these claims is respectfully traversed for the reasons provided below. Arguments which support the patentability of the pending claims are first provided with reference to independent claim 1. These arguments are then incorporated in defense of the remaining independent and dependent claims.

1. Independent Claim 1

Claim 1 recites a quadrature modulator compensation system for compensating the transmission of a source signal provided by a signal source data generator. The quadrature modulator comprises a transmitter which translates a baseband transmitter input signal to a local oscillator frequency to generate a transmitter output signal. The recited quadrature modulator compensation system also comprises "calibration circuitry coupled to the transmitter and generating a phase error estimate of the transmitter as a function of an angle of intersection between a desired transmitter envelope and an actual transmitter envelope." Finally, as recited in claim 1, the quadrature modulator comprises "predistortion circuitry coupled to the signal source, the transmitter and the calibration circuitry, the predistortion circuitry receiving the source signal

and the phase error estimate of the transmitter as inputs and providing as an output the transmitter input signal as a function of the phase error estimate of the transmitter".

2. Stated Basis of Rejection and Examiner's Responses to Applicant's Arguments

In support of the rejection of claim 1, in section 8 the Office Action stated that Carney discloses a predistortion detection technique comprising "[c]alibration circuitry . . .coupled to the transmitter which receives a correction signal from the predistortion processor and source signals (121) to generate an error estimate of the transmitter." Next, the Office Action states that Carney's predistortion technique also comprises "[p]redistortion circuitry [that] receives the source signal (121) and uses the phase error estimate of the transmitter as an input and provides as an output the transmitter input signal as a function of the phase error estimate." However, in direct conflict with the assertion made in section 8 that Carney's predistortion technique uses a phase error estimate of the transmitter as an input, in section 2 the Final Office Action states: "The examiner admits that Carney fails to teach calibration circuitry generating a phase error estimate in any manner." Further, in section 3 the Final Office Action states: "The examiner admits that Carney is silent as to the use of phase error estimate in the transmitter."

Next, in section 8 the Final Office Action states that Carney does not disclose in the calibration circuitry the use of an ***angle of intersection*** between a desired transmitter envelope and an actual transmitter envelope in the generation of a phase error estimate, nor does it include a quadrature compensation system. Note the statements above in which it was admitted in the Office Action that Carney "fails to teach calibration circuitry generating a phase error estimate in any manner" and that "Carney is silent as to the use of phase error estimate in the transmitter." Again, in and effort to address this gap, the Final Office Action relies upon Kafadar, stating that this patent teaches a "Phase-Shift Keying (PSK) modulation system having a quadrature calibration of a vector demodulator using a statistical approach for analysis and correction of received data." The Office Action concludes that "[i]t would have been obvious . . . to incorporate Kafadar's quadrature modulator teachings into Carney's modulator correction system

because PSK is an efficient modulation scheme for digital transmission." The rejection of claim 1 and the remaining claims is respectfully traversed for the reasons set forth below.

3. Claims 1-9 are Not Obvious in view of Carney and Kafadar

The mere fact that references ***can*** be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). Although a prior art device "may be capable of being modified to run the way the apparatus is claimed, there must be a suggestion or motivation in the reference to do so." 916 F.2d at 682, 16 USPQ2d at 1432. The level of skill in the art cannot be relied upon to provide the suggestion to combine references. *Al-Site Corp. v. VSI Int'l Inc.*, 174 F.3d 1308, 50 USPQ2d 1161 (Fed. Cir. 1999). "In determining the propriety of the Patent Office case for obviousness in the first instance, it is necessary to ascertain whether or not the reference teachings would appear to be sufficient for one of ordinary skill in the relevant art having the reference before him to make the proposed substitution, combination, or other modification." *In re Linter*, 458 F.2d 1013, 1016, 173 USPQ 560, 562 (CCPA 1972).

According to Section 2142 of the Manual of Patent Examining Procedure (M.P.E.P.), the Examiner bears the initial burden of actually supporting a *prima facie* conclusion of obviousness. In order to establish a *prima facie* case of obviousness in instances where multiple references are cited in combination, the Examiner must show **(1) that a suggestion exists for combining the references, and (2) that the combined references teach or suggest all of the recited claim limitations.** Id.

3a. No Suggestion Exists for Combining the References

As a first reason as to why the rejection of claims 1-20 should be withdrawn, the alleged obviousness of each of the pending claims is based on a standard of motivation to combine prior art references that is so loose that it becomes impossible not to satisfy. If such a standard were recognized as satisfactory, it would leave meaningless any requirement of a motivation to combine.

It is an essential step in establishing a *prima facie* case of obviousness to show that the

references, when considered as a whole, suggest the desirability of the combination of elements. See In re Kotzab, 55 USPQ2d 1313 (Fed. Cir. 2000); M.P.E.P. 2143.01 (The showing of motivation to combine the elements is an essential component of an obviousness holding, and must be established with specific findings of fact based on objective evidence). See also In re Lee, 61 USPQ2d 1430 (Fed. Cir. 2002); MPEP § 2143.01 (These requirements are crucial for preventing "the nature of the problem to be solved" from becoming an ambiguous catchall that is indistinguishable in practice from impermissible hindsight).

While the invention associated with the pending claims is related generally to radio communication technology, and more specifically to a quadrature *modulator* compensation system for compensating the transmission of a source signal provided by a signal source data generator, Carney discloses a distortion correction technique in a cellular environment. It is this aspect of Carney, which has been combined with the teaching of Kafadar, calibration of vector *demodulators* associated with "wireless/cellular networks", to reject the pending claims.

It is respectfully submitted that the motivation to combine provided in the Office Action is a demonstration of exactly what the requirement of an objective showing of obvious combinability is trying to avoid. The Office Action provides no reasonable rationale as to why it would be obvious to combine the cited references. The only evidence provided in the Office Action in support of the proposed combination of the Carney and Kafadar is their use in "wireless/cellular networks". When considered as a whole and therefore viewed in the proper context of the disclosure provided by Kafadar (calibration of vector *demodulators* for receiving data *transmitted* by means of quadrature modulation format), Appellant respectfully points out that this cited motivation really has nothing to do with the invention associated with the pending claims (quadrature *modulator* compensation system for compensating the *transmission* of a source signal provided by a signal source data generator). Nor is it a motivation that would lead to the invention recited in the pending claims. Not only does this trivialize the requirement of a factual inquiry of objective evidence to the point of becoming indistinguishable from impermissible hindsight, it arguably imposes an impossible standard by which any combination of elements from any combination of references would provide some recognizable advantage allegedly sufficient to be cited as an appropriate motivation to

combine.

Neither is the proposed combination supportable on the theory that the nature of the problem to be solved suffices to provide motivation to combine elements. This was the theory advanced in Ruiz v. A.B. Chance Co. where the Court of Appeals for the Federal Circuit deferred to the district court's finding that the nature of the problem to be solved provided motivation to combine elements of background references, because the combination addressed the same problems and reached the same result as the subject matter of the references. Ruiz v. A.B. Chance Co., 69 USPQ2d 1686 (Fed. Cir. 2004). In Ruiz, the Court of Appeals for the Federal Circuit contrasted this standard with "combining various existing features or principles in a new way to achieve a new result – often the very definition of invention." Ruiz at 1690. The Court identified this distinction as crucial in fulfilling the statutory mandate to weigh obviousness against the invention "as a whole," noting that virtually all inventions are combinations of old elements. The Court of Appeals for the Federal Circuit specifically approved of the district court's finding, primarily "because the two references address precisely the same problem" as the subject matter of the claimed invention (Ruiz at 1690), and "because the prior art references address the narrow problem of underpinning existing building foundations, a person seeking to solve that exact same problem would consult the references and apply their teachings together" (Ruiz at 1691).

The Court therefore defined both sides of a clear rule: where each underlying reference addresses "precisely the same problem" and achieves the same result as the claimed invention, it may be proper to find motivation to combine elements due to the nature of the problem to be solved; on the other hand, combining various existing features or principles in a new way to achieve a new result is often the very definition of invention and where the claimed invention addresses a different problem or achieves a different result than at least one of the references, this falls in the definition of invention, and outside the realm of what might have been motivated by the nature of the problem to be solved. Weighed against this rule, the rejections in the Office Action of the present case fall squarely into the catchall realm of improper hindsight.

Kafadar makes no reference to solving the problem of losses within the analog circuits of a transmitter. The Office Action cited Kafadar's Background of the Invention at Col. 1, lines 18-

32 in support of the combination Carney and Kadafar: "Demodulators for data that is transmitted with quadrature modulation, such as phase shift keyed (PSK) data, can introduce losses into the received data as a result of various conditions inherent in the demodulator". The cited section makes no mention of losses from the transmitter, or correcting for these losses before a signal is transmitted to the demodulator. This reference teaches that losses can be introduced by "various conditions *inherent* in the *demodulator*" and can be corrected after transmission to the demodulator. Therefore the problem which Kafadar solves is different than the problem the present invention solves. The result is similarly also different. Modulation of the signal occurs after it has been received by the demodulator, while in the present invention compensation occurs before the signal has been transmitted. The result is that in Kafadar the signal is compensated for after being received, while the present invention compensates the signal before it is sent.It is respectfully maintained that no teaching or suggestion has been identified which would properly support a combination of Carney and Kafadar. As admitted in the Final Office Action, Carney does not disclose a quadrature modulator compensation system. Likewise, Kafadar does not disclose a quadrature modulator compensation system either, but rather it discloses calibration of vector ***demodulators*** for receiving data transmitted by means of quadrature modulation format. The Final Office Action states in section 6 that "Kafadar discloses a calibration method in which both the angular difference, or phase estimate and the DC offsets are determined and input as calibration data to the transmitter." However, in direct conflict with this statement, in section 4 of the Final Office Action it is admitted that Kafadar does not disclose a quadrature modulator with the statement: "Kafadar does not discuss the use of these determined parameters in terms of predistortion circuitry for a transmitter." Notwithstanding the unsupported statement that it would be obvious to incorporate Kafadar's calibration teaching into Carney's modulator correction system "because PSK is an efficient modulation scheme for digital transmission", there is no teaching or suggestion to combine the vector ***demodulation*** calibration teachings of Kafadar, relating to ***receiving*** data in a quadrature modulation format, with the ***transmitter or modulator*** predistortion teachings of Carney. This is even more evident given that fact that Carney has been admitted to not teach quadrature modulation.

3b. The combined references do not teach or suggest all of the recited claim limitations

Even if a combination of Carney and Kafadar were proper, the combination would still fail to teach every element of the invention recited in independent claim 1. Claim 1 recites "calibration circuitry coupled to the transmitter and generating a phase error estimate of the transmitter as a function of an angle of intersection between a desired transmitter envelope and an actual transmitter envelope." The Final Office Action references Kafadar (at col. 4) stating that the angular difference between the ideal quadrature and the actual quadrature can be thought of as the phase error estimate as a function of the angular difference between the desired signal envelope and the actual envelope. The angular difference cited in Kafadar uses the angle difference between the two principle axis (Col. 5, lines 11-16). The angular difference is then determined by computing the difference between the angle difference and 90 degrees. The angular difference is a measure of the skew of the principle axis (Col. 5, lines 29-33). The angluar difference cited in Kafadar is different than the angle of intersection used in claims 1, 10 and 15.

Assuming for the moment (without prejudice) that the Office Action statement accurately describes the teachings of Kafadar, it does not provide a teaching of this limitation of claim 1. The errors for which Kafadar wishes to compensate in the demodulator are a result, at least in part, of ***demodulator*** (i.e., receiver) component errors. See for example Kafadar at col. 3, lines 42-68. Kafadar does not support a conclusion that the angular difference is between the desired ***transmitter*** envelope and the actual ***transmitter*** envelope.

In addition to the fact that the phase error estimate defined in the Office Action is not the same as the phase error estimate required by the language of claim 1, there is no teaching or suggestion in either of Carney or Kafadar to predistort a signal source, ***as a function of the phase error estimate of the transmitter***, to provide a transmitter input signal. As admitted by the Examiner in the Final Office Action, while Carney does teach the generation of a predistortion signal, Carney does not teach providing a predistortion signal as a function of a phase error estimate. As was also admitted in the Final Office Action, Kafadar does not teach the use of the

phase error estimate (and other parameters recited in dependent claims) in terms of predistortion circuitry for a transmitter, but rather in terms of calibration of a ***demodulator***. Therefore, since neither of the cited references teaches or suggests predistortion circuitry which receives the source signal ***and the phase error estimate of the transmitter*** as inputs, and provides as an output ***the transmitter input signal as a function of the phase error estimate of the transmitter***, this combination of references cannot render claim 1 obvious. Consequently, in view of the above arguments, it is respectfully submitted that independent claim 1 and dependent claims 2-9 are in condition for allowance. It must be noted that, in addition to their dependence from claim 1, claims 2-9 also contain additional subject matter which renders these claims patentable. Reconsideration and withdraw of the rejections of claims 1-9 are therefore requested.

4. Claims 10-20 are Not Obvious in view of Carney and Kafadar

Independent claim 10 is directed to a method of compensating transmission of a source signal in a quadrature modulator. Among others, the method includes the step of "determining a phase error estimate of the transmitter as a function of an angle of intersection between the desired transmitter envelope and the actual transmitter envelope." The method also includes the step of predistorting the source signal to generate a transmitter input signal, "wherein the transmitter input signal is generated as a function of the source signal and the determined phase error estimate." In view of the arguments provided in support of independent claim 1, it is clear that these limitations of independent claim 10 are neither taught nor suggested by the cited combination or references. Since claims 11-14 depend from independent claim 10, these claims are patentable over the cited combination for these reasons in addition to the further limitations found in these claims.

Independent claim 15 is directed to a quadrature modulator compensation system for compensating the transmission of a source signal. As recited in claim 15, the system includes calibration circuitry coupled to a transmitter and "configured to generate at least one of a phase error estimate of the transmitter as a function of an angle of intersection between a desired transmitter envelope and an actual transmitter envelope, a gain error estimate of the transmitter as

a function of variation in the actual transmitter envelope, and a dc offset estimate in an in-phase component and a quadrature component of the source signal as a function of a centroid of the actual transmitter envelope." Finally, claim 15 recites "predistortion circuitry receiving the source signal and at least one of the phase error estimate, the gain error estimate, and the dc offset estimate as inputs and providing as an output the transmitter input signal as a function of at least one of the phase error estimate, the gain error estimate, and the dc offset estimate."

Since both Carney and Kafadar are silent as to predistortion circuitry receiving at least one of a calibration circuitry generated phase error estimate, gain error estimate, or dc offset estimate as inputs and providing as an output the transmitter input signal as a function of the at least one of the calibration circuitry generated phase error estimate, the gain error estimate, and the dc offset estimate, it is submitted that the combination of steps recited in independent claim 15 are neither taught nor suggested by the cited references. Since claims 16-20 depend from independent claim 15, these claims are patentable over the cited combination for this reason in addition to the further limitations found in these claims. Reconsideration and withdraw of the rejections of claims 10-20 are therefore respectfully requested.

The Director is authorized to charge any fee deficiency required by this paper or credit any overpayment to Deposit Account No. 18-1722.

Respectfully submitted,

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